

Cryospheric Applications of LDCM / Landsat-8

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An aerial photograph of a massive glacier flowing through a series of rugged, snow-capped mountain peaks. The glacier's surface is marked by numerous longitudinal crevasses and transverse ridges, indicating its slow but powerful movement. The surrounding mountains are partially covered in snow and ice, with some rocky outcrops visible. The sky is a pale, hazy blue, suggesting a clear but slightly overcast day.

Main Goals

Promote use of Landsat-8 by the polar and glacier communities

Acquire data that supports wide range of science applications

Conduct a series of key studies, validate a number of techniques

Demonstrate effectiveness of the Landsat-8 sensors

Acquisitions for ice and glaciers

Start with existing and past **L-7** plans; minor adjustments;

Repeat the LIMA acquisition plan for Antarctica in 2014-2015;

Greenland is of major importance; 15 March to 15 October

Continue high-frequency coverage of **temperate glaciers** in fall;

Sea ice study area north of Alaska and Canadian Arch. (2 areas)

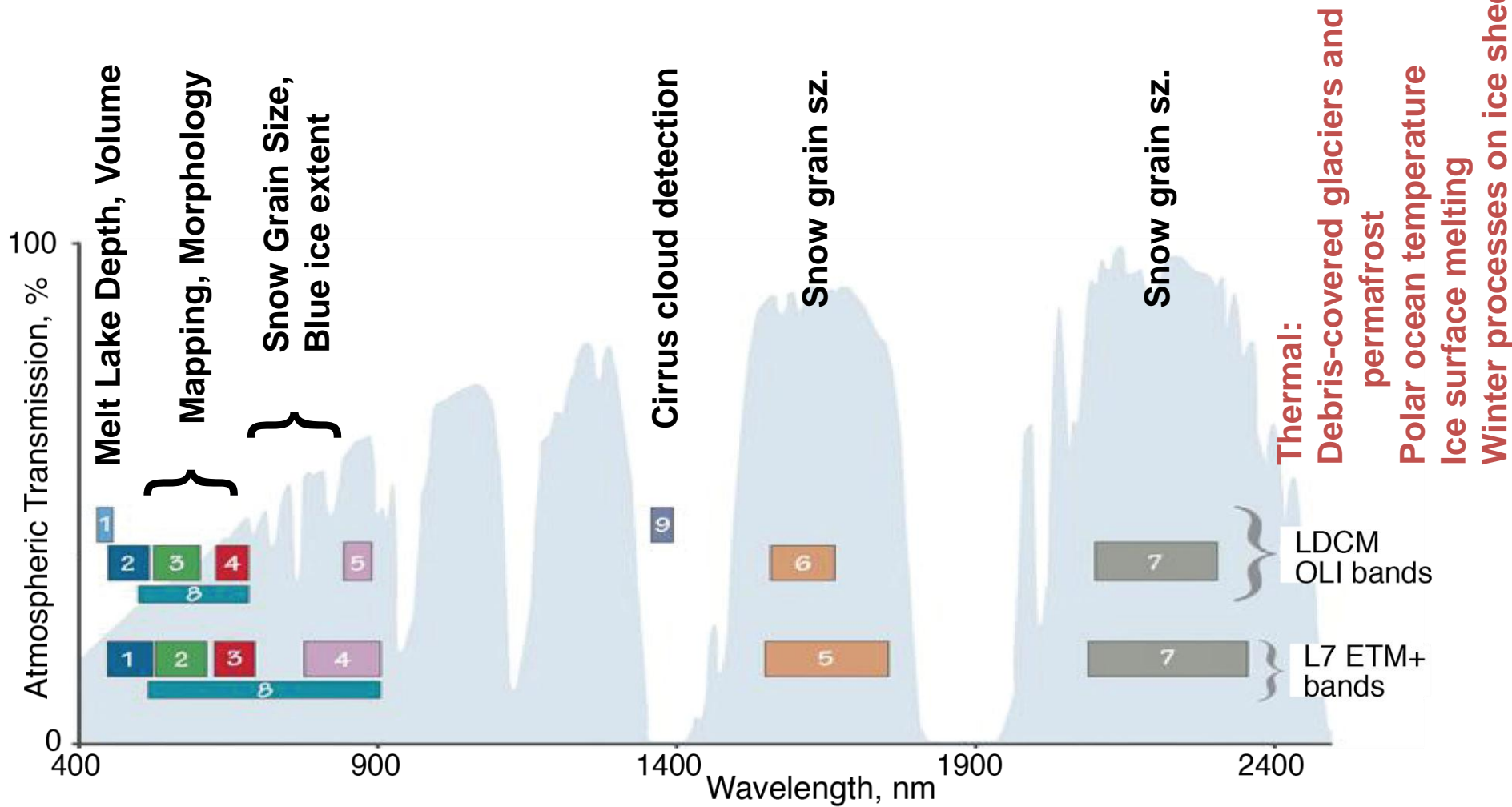
New targets for thermal channel (polar night, ascending node):

permafrost, debris-covered glaciers, ice sheet coastlines,

Antarctic winter targets for coldest surface temperatures.

**Nighttime acquisition in late summer over
glacier and permafrost targets**

Snow and Ice and the Landsat 8 bands



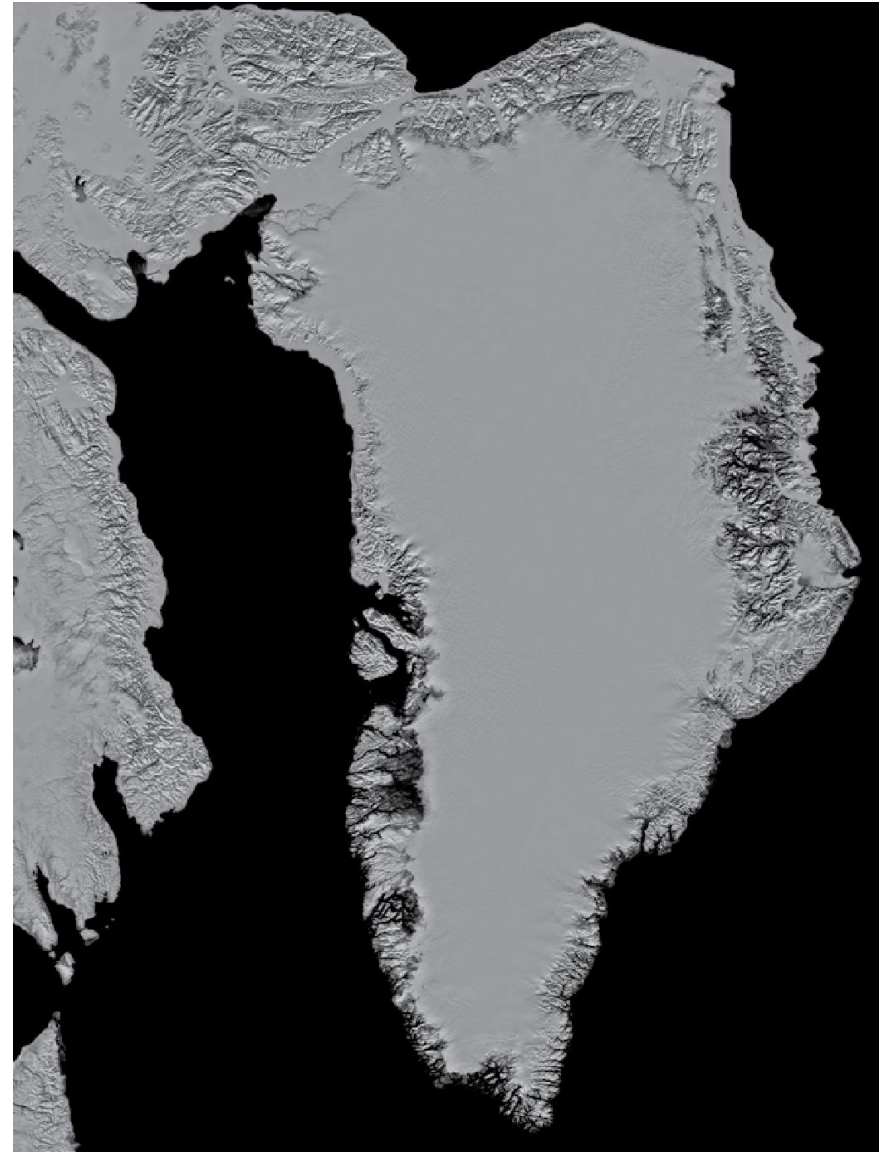
Landsat-8 Ice Sheet Applications

Ice edge, floating ice front extent mapping;

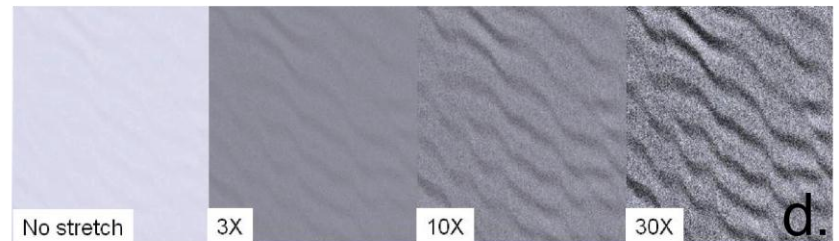
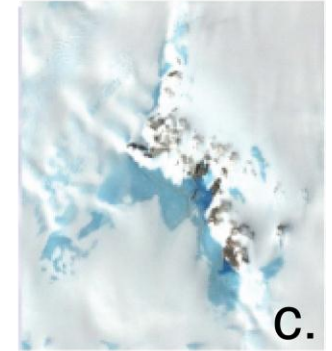
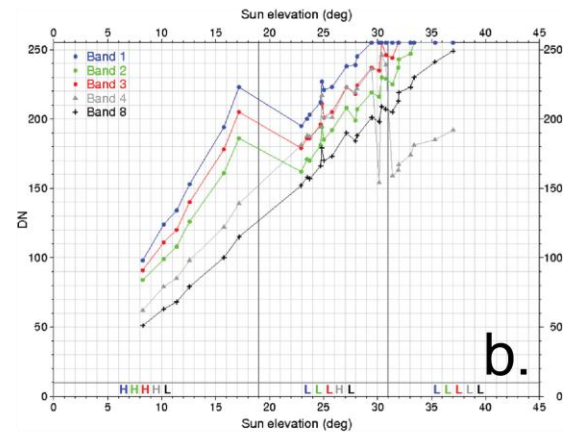
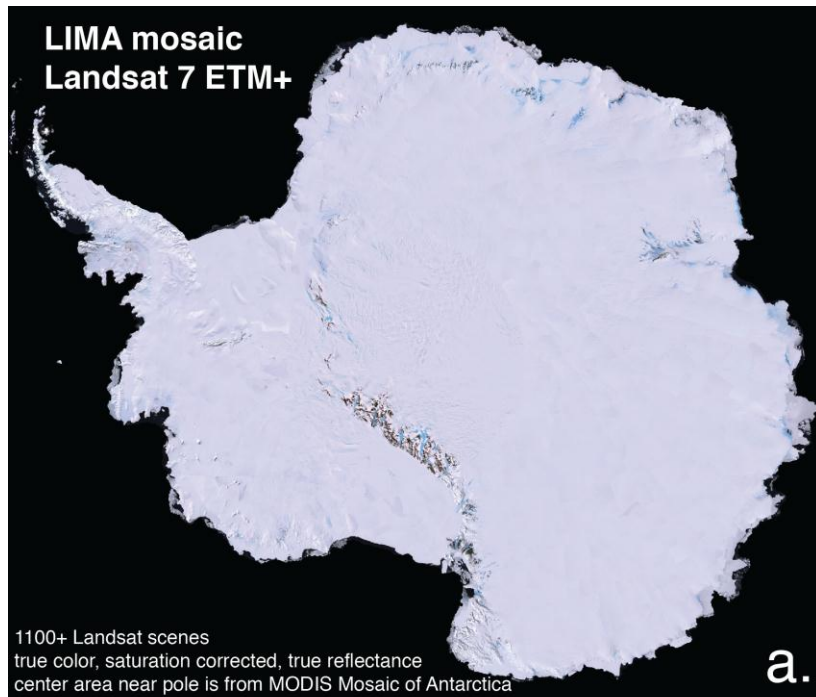
Mapping of 'grounding line';

Topography and morphology;

Spectral measurements –
 albedo
 snow grain size
 blue ice extent
 melt extent
 ice sheet zones (facies)



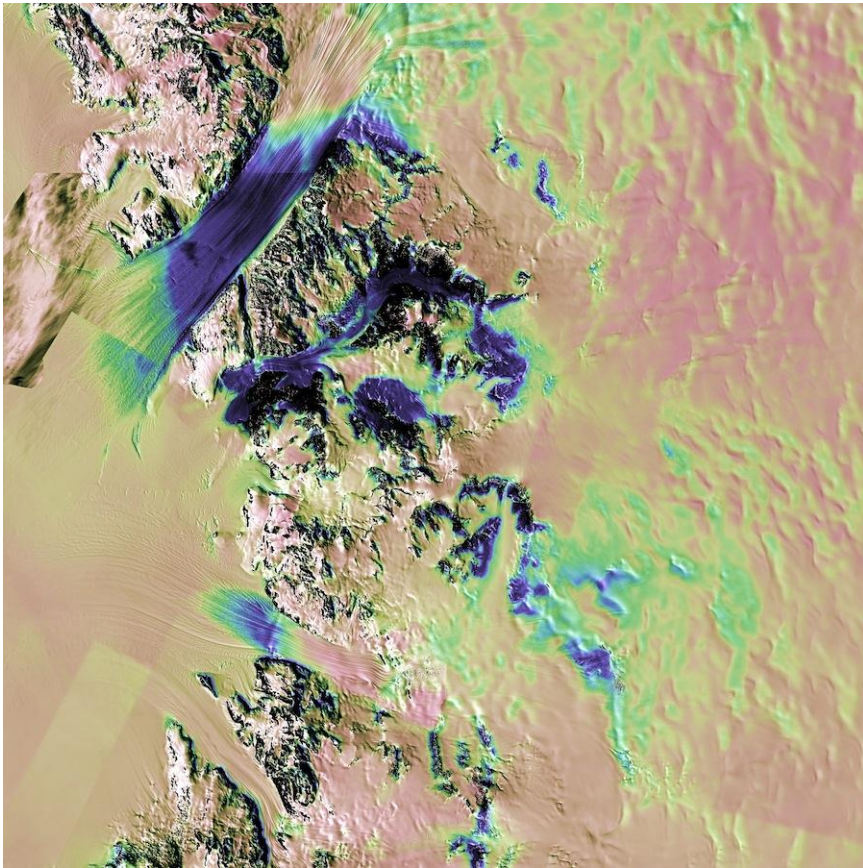
Mapping Antarctica – LIMA (Landsat Image Map of Antarctica)



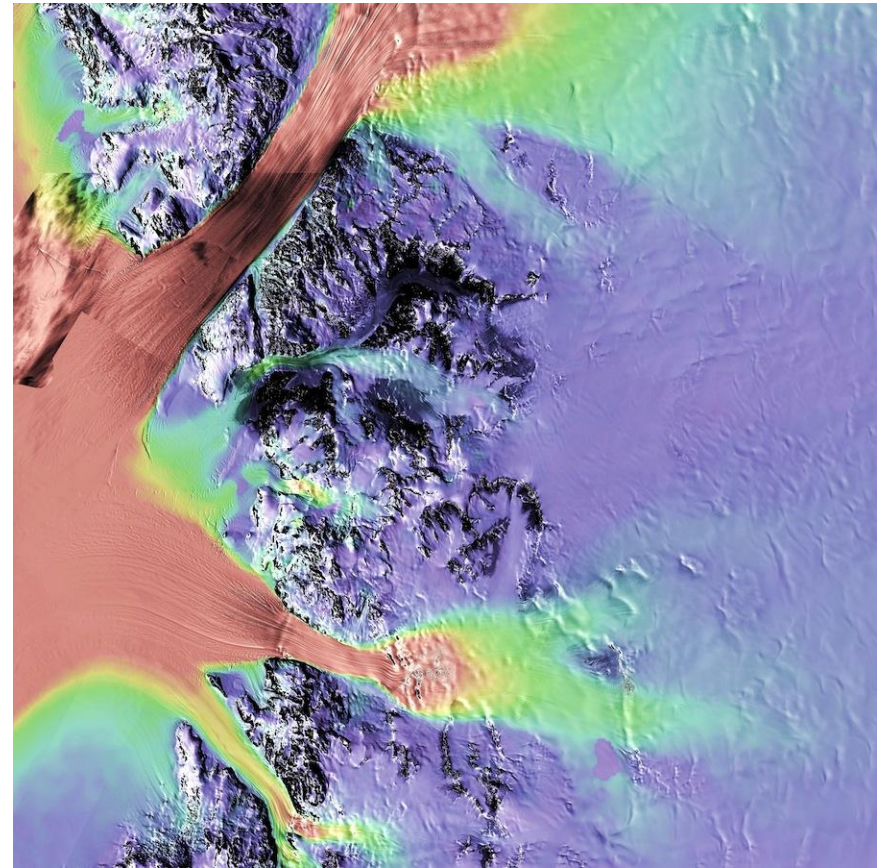
- several further products can be derived from the LIMA data set:
snow grain size, blue ice extent, snow structure mappings (e.g., dunes, flowstripes)
- plan to acquire data to support a Greenland or Arctic-wide LIMA-style mapping
- repeat (LIMA-L8) will support refined mapping, continent-wide change detection

Mapping Antarctica – LIMA (Landsat Image Map of Antarctica)

False color grain size



Velocity over LIMA



Melt ponds on ice sheets – area / volume measurements

Effects of melt ponds:
acceleration of flow
enhanced fracturing

Uses new 'Coastal' band
-ratio with red or NIR band

Western Greenland,
Antarctic Ice Shelves
Arctic sea ice



Landsat-8 Glacier Applications



polar glaciers

*ice front extent, crevasses, ice velocity,
summer melt extent, dust or soot(?)
elevation change*

Feature tracking, albedo, ocean therm.

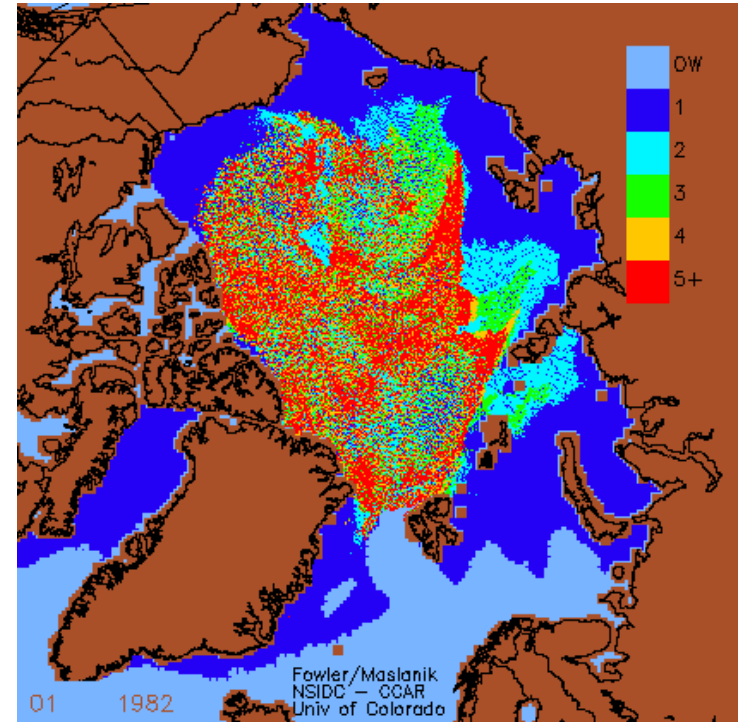


mountain glaciers

*Glacier extent beneath debris cover,
ice velocity, equilibrium line altitude,
dust or soot on snow; elevation change*

Mapping (w/DEM), thermal data, feat. track.

Landsat-8 and Arctic Sea Ice



- rapid decline due to Arctic warming: sea ice structure, thickness changes
- collect selected area repeatedly to document sea ice type changes, melt ponding

Potential LDCM studies

Snow grain size and blue ice extent on ice sheets from LIMA / MOA

Morphology of ice sheets and ice shelves
(comparison of 'sensitivity' to past sensors)

Feature tracking w/ Landsat legacy comparison

Lake extent, depth, and volume in western Greenland / AP

Image differencing and sub-ice-sheet water movement

Photoclinometry / shape-from-shading at grounding line and
interior undulation

Thermal mapping of polar ice sheets, winter inversion layer,
ocean SST at the ice fronts.

LDCM / Landsat-8 Cryosphere group

- **Ted Scambos** (PI) is a Senior Research Scientist, and Lead Scientist at NSIDC, a part of University of Colorado; ice sheet mapping, polar field geophysics, climate change in polar regions, sea ice processes
- **Robert Bindshadler** (Co-I, contractor) is an emeritus scientist for NASA affiliated with the Cryospheric Sciences group at GSFC
- **Terry Haran**, senior programmer and geospatial mapping expert, NSIDC
- **Jennifer Bohlander**, data analysis and image processing, NSIDC
- **Patricia Vornberger**, data processing, GSFC contracting firm
- **Allen Pope**, spectral mapping of mountain glaciers; polar remote sensing; will be a post-doc at NSIDC, Fall 2013

Questions?

